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**SYSTEM ANDM METHOD OF MOUNTING A DISPLAY
SCREEN VIA A PENDULUM TYPE MOUNT**

INVENTOR:

JEFF CARTER

SUBMITTED BY:

**KOESTNER BERTANI, LLP
4201 W. PARMER LANE
SUITE A-100
AUSTIN, TEXAS 78727
(512) 399-4100 - TELEPHONE
(512) 692-2529 - FACSIMILE**

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Rebecca J. Morrison

SYSTEM AND METHOD OF MOUNTING A DISPLAY SCREEN
VIA A PENDULUM TYPE MOUNT

TECHNICAL FIELD OF THE INVENTION

5 **[0001]** The present invention relates generally to systems and methods of mounting a display screen, and more particularly, a system and method that utilizes a pendulum mount to hold a display screen in a variety of positions for a reclined or unreclined viewer.

BACKGROUND OF THE INVENTION

[0002] Before and during a dental procedure, dentists or their assistants typically discuss the procedure with the patient. To facilitate this discussion, a view screen or other visual aid that can be easily positioned and then removed from the immediate field of view is desirable. This screen assists the dentist in describing the procedure to patients and allows the results of photos, X-rays or other tests performed to be shown to the patient. Existing systems do not provide a visual aid than can be easily positioned near and then removed from the patient's field of view. Additionally, existing display screens cannot be positioned to allow a patient to view the display screen in an upright position before the dental procedure begins, and in a reclined position that allows the patient to be entertained during the actual dental procedure.

[0003] During dental procedures, the patients lay in a horizontal rather than vertical position. Thus, a display screen capable of being easily viewed in both a horizontal and a vertical position would satisfy this need. In addition to showing patients information regarding their procedure, patients may view DVD, television or other form of entertainment during the procedure. This entertainment would significantly improve their experience at the dentist.

[0004] No fixed point exists where a monitor or other visual aid can be mounted that addresses these needs. One solution involves mounting an actual television in the ceiling of a dental office. However, problems associated with this solution include the risk of heavy equipment falling onto the patient. Additionally, the mechanical supports for such systems are typically bulky and cumbersome. Another solution places a television set on a fixed brace at a 45-degree angle. While this provides a better solution, the solution creates problems in

viewing the display screen in both the vertical or the horizontal position as the patient is always at a 45-degree angle to the display screen. Additionally, patients often recline in a past horizontal position decreasing the usefulness of this solution.

5 This position arises from many dental procedures, which often require the patient's head to be inclined further for access. Furthermore, the television mounts to a fixed location and cannot be repositioned for individual patients.

[0005] Mounting a display screen at a 45-degree angle does not
10 provide a solution for most cases. Flat panels displays may not be clearly viewed as the viewers angle deviates from normal. Furthermore, mounting a television in the ceiling creates a hazard if the television were to fall, and operational problems for televisions, which were not designed to operate in a
15 horizontal position. Additionally, instances exist when the dentist would prefer to show the patient an intra-oral picture taken during the procedure to facilitate authorizing changes to the scope of the dental procedure. Previously, the patient would sit up for this discussion, while the procedure was temporarily
20 stopped.

[0006] Another problem associated with existing solutions are bulky cables, which distract the patients' view. In the prior art solution shown in FIGURE 1, a monitor 10 mounts to ceiling 12 via bracket 14, wherein cables 16 run along the exterior of the
25 bracket and ceiling. Visible cables 16 quite often are unsightly. Additionally, support arm 18 is relatively short and does not bring the view screen near the patient. Thus a need exists for a mount with multiple degrees of freedom that allows a display to be positioned so that a dental patient may view the
30 display during all phases of dental procedures or be easily removed and not interfere with the dental procedure.

SUMMARY OF THE INVENTION

[0007] The present invention provides a pendulum mount to support a display screen that substantially eliminates or reduces disadvantages and problems associated with previously developed systems and methods used to mount a display screen. The pendulum mount includes a ceiling mount attached to the ceiling or other support with cables that run within the ceiling mount to a support arm mechanically coupled to the ceiling mount. A first joint mechanically couples the ceiling mount to the support arm and the cables exit the ceiling mount and enter the support arm at the first joint. Then, the cables run within the support arm to a second joint. A mounting assembly that supports the display screen is mechanically coupled to the support arm at the second joint. As with the first joint, the cables exit the support arm and may either enter the mounting assembly at the second joint or directly couple to the display screen. These cables provide video feeds, audio feeds, or power supplies to the display screen.

[0008] In one embodiment, the ceiling mount is composed of a conduit and a base wherein the base is mechanically coupled to the ceiling and the conduit. A first degree of freedom exists in that the conduit may rotate $\pm 360^\circ$ relative to the base. Tension between the support arm and the ceiling mount prevents the support arm from resting in a neutral position. This is because the tension between the support arm and the ceiling mount, which may be exerted by a gas tension spring, or other like device known to those skilled in the art, counterbalances the display screen mounted operably coupled to the support arm at the second joint.

[0009] In another embodiment, the tension between the support arm and the ceiling mount is provided by a friction hinge. The mounting assembly may be made to comprise a second conduit and a rotator mechanically coupled to the second conduit. The rotator

allows the display screen to be rotated $\pm 360^\circ$ relative to the rotator while the second joint provides an additional degree of freedom by adjusting the angle in the Z-axis relative to the display screen. Additionally, tension between the support arm and the mounting assembly prevent the display screen from merely resting in a neutral position. Cables may travel along a channel within the first joint and the second joint in order to hide the cables from view.

[0010] Yet another embodiment of the present invention provides a pendulum mount to support a display screen for a dental patient. This pendulum mount includes a ceiling mount having a conduit and a base that mechanically couples to the ceiling as well as the conduit. The conduit is operable to rotate $\pm 360^\circ$ relative to the base and cables for power, video, audio or other feeds to the display screen run within the conduit. A support arm mechanically couples to the ceiling mounts with a first joint. The cables exit the conduit at the first joint and enter the support arm. Then the cables run within the support arm to a second joint. Tension between the support arm and the ceiling mount prevents the support arm from resting in a neutral position. This is achieved by choosing tension springs, mechanical springs, gas pistons, or other systems known to those skilled in the art, to counterbalance the moment of the display screen at the far end of the support arm. A mounting assembly at the far end of the support arm supports the display screen for the dental patient. Additionally, the mounting assembly mechanically couples to the support arm via the second joint. As with the first joint, cables exit the support arm and enter the second joint and then run within the mounting assembly and are operably coupled to the display screen. Alternatively the cables exit the support arm and directly couple to the display screen. This allows the display screen to be positioned such that the line of sight of the patient is normal to the XY plane of the

display screen no matter the position or inclination of the patient. For example, the patient may be in a reclined position, reclined past horizontal or upright position while the present invention allows the patient's line of sight to be normal to the

5 XY plane of the display screen.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which like reference numerals indicate like features and wherein:

[0012] FIGURE 1 illustrates one prior art solution;

[0013] FIGURES 2A and 2B illustrate a pendulum mount in various positions;

[0014] FIGURES 3A and 3B depict the freedom of motion associated with the display screen;

[0015] FIGURE 4 illustrates how the support arm can rotate about the pendulum mount;

[0016] FIGURE 5 depicts how the support arm can swing relative to the pendulum mount;

[0017] FIGURE 6 further illustrates one component of the pendulum mount;

[0018] FIGURE 7 further illustrates the top hinge tube of the pendulum mount that couples to the component of FIGURE 6;

[0019] FIGURE 8 depicts three views of one embodiment of one half of the hinge;

[0020] FIGURE 9 illustrates the friction wheel which resides within the hinge components;

[0021] FIGURE 10 illustrates a fully extended hinge with cables running within the hinge;

[0022] FIGURE 11 illustrates a full hinge bent at 90° with cables running within the hinge;

[0023] FIGURE 12 provides an example of how the support arm is balanced by tension springs;

[0024] FIGURE 13 provides two view of an assembled mounting assembly;

[0025] FIGURE 14 depicts the rotator of the mounting assembly;

[0026] FIGURE 15 provides a drawing of the rotator cap used to affix the rotator to the support plate; and

[0027] FIGURE 16 illustrates the support plate on which a view screen is mounted.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Preferred embodiments of the present invention are illustrated in the FIGURES, like numerals being used to refer to like and corresponding parts of the various drawings.

5 **[0029]** The present invention provides a pendulum mount for a monitor, visual display or other vertical work surface. A ceiling mount hingedly attaches to a support arm at a first joint. On the opposite end of the support arm a second joint allows a flat panel display or monitor to be attached. Optical,
10 electrical, or other like cables for the display screen or monitor run internally within the support arm, and ceiling mount in order to remove unsightly cables from view. Joints comprise a friction joint or other like joint as known to those skilled in the art. These joints provide tension that allow the support arm
15 to be positioned anywhere within its range of motion without returning to a neutral position.

[0030] FIGURES 2A, 2B and 2C illustrate one embodiment of the present invention. Here, pendulum mount 20 mounts to ceiling joist 22 via base 24. Drop ceiling 26 is illustrated as a cutout
20 wherein flange 28 covers the interface with the ceiling. Top hinge tube 30 attaches to base 24 via a series of threads or other like means. Top hinge tube 30 may rotate up to 360 degrees in either direction within base 24. This rotation provides one degree of freedom. This rotation helps to allow support arm 34
25 to be positioned into any orientation. Hinge 32 couples top hinge tube 30 to support arm 34 and provides a second degree of freedom. To prevent support arm 34 from resting in a vertical or neutral position, gas tension springs 36 or other like devices as known to those skilled in the art, place sufficient tension on
30 support arm 34 to counterbalance the moment of display 38. This counterbalance prevents support arm 34 from swinging free to a vertical or neutral position.

[0031] FIGURE 2B depicts pendulum mount 20 in a neutral position with support arm 34 in a vertical position. In this position gas tension springs 36 are fully extended. Support arm 34 couples to a display screen 38 via lower hinge 40.

5 [0032] FIGURES 2A and 2B depicts hinge 40 as a friction hinge. Mounting assembly 42 mechanically couples to display 38 and support arm 34 at hinge 40. The mounting assembling may have a conduit within which cables 42 run, or alternatively, these cables may exit support arm 34 and directly couple to display 38.
10 A rotator allows display 38 to rotate +/- 360° within its XY plane relative to the mounting assembly. Hinge 40 allows display 38 to be repositioned at an angle to the longitudinal axis of support arm 34. Additionally, when support arm 34 is in a horizontal position the gas springs 36 retract to support or
15 counterbalance the moment caused on support arm 34 by display 38. Although gas tension springs are illustrated as one means to counterbalance the moment caused by display 38, other mechanisms known to those skilled in the art may be used to counterbalance the moment. One example includes a ratcheting mechanism that
20 locks support arm 34 at various pre-determined angles.

[0033] Rotator 42 couples hinge 40 to display screen 38 allowing display 38 to freely rotate in the XY-plane. This allows a dentist, patient, or other user to view the display screen in either a landscape or portrait mode. Display screen 38
25 can also be positioned in any intermediate orientation between portrait and landscape as shown in FIGURE 3A.

[0034] FIGURE 3A provides a front view of display screen 38 rotating a full 360 degrees while FIGURE 3B illustrates that display screen 38 can be rotated from top to bottom in tilt as
30 provided by lower hinge 40. While cables are not shown in FIGURES 2A through 2C, cables exit top hinge tube 30 at hinge 32 and then enter arm 34 at its hinged connection to tube 30.

[0035] The ratcheting concept may also be used at hinge 40 to position display screen 38 at various predetermined angles. A disadvantage associated with the ratcheting concept occurs if a failure of the ratcheting mechanism takes place or the inability of a user to reach high enough to disengage the ratcheting mechanism of arm 34 in a position parallel to the ceiling. Counterbalance provided by the gas tension springs 35 allow users to position display screen 38 throughout the entire range of motion with minimal force.

[0036] FIGURE 4 illustrates the range of motion available at the base and at the viewing screen. As shown here, support arm 34 freely rotates 360 degrees around base 24 in either direction. Similarly, display screen 38 rotates between portrait and landscape no matter the orientation of the viewer. FIGURE 4 failed to show the range of motion associated with hinge 32 and hinge 40 which allow support arm 32 to be repositioned and angled to the plane of the ceiling and the XY plane of the displaced screen 38. These angles are better illustrated in FIGURE 5.

[0037] FIGURE 5 provides a cross-section of the present invention. Here, all cables enter through a plenum inside the pendulum mount tube or base 24. Thus, the visual exposure of the cables is minimized. Flange 28 serves to interface between the pendulum mount tube 24 and the drop ceiling 26. As shown, support arm 34 freely moves to all positions within a 180-degree arc from a non-use storage position 50 through an upright consultation viewing position 52, and supine viewing position 54. Two finely threaded tubes may facilitate the rotation of arm 34 about the pendulum mount tube 24. One may notice that as the support arm 34 transitions from storage position 50 upright, consultation position 52, and a reclined viewing position 54, that the counterbalance springs are fully extended in the upright or consultation position 52 while fully retracted in the storage position 50 for reclined viewing position 54. In the non-

extended positions, the gas tension springs 36 counterbalance the moment on support arm 34 caused by display 38. Additionally, this counterbalance allows display 38 to be movable to all positions within a 180-degree arc. This is in contrast to a system employing a ratcheting system where the support arm 34 can only be positioned at discrete angles relative to the viewer.

[0038] FIGURE 6 depicts pendulum tube mount 24 in further detail. In FIGURE 6, base 60 attaches to pendulum mount tube 62 via a weld or other fastening means as known to those skilled in the art. The interior surface of pendulum mount tube 62 is threaded to receive the top hinge tube 64. This threading allows pendulum mount tube 62 to freely rotate $\pm 360^\circ$ degrees relative to base 60, which is coupled to the ceiling.

[0039] FIGURE 7 further illustrates top hinge tube 30 wherein threads 64 along the upper half of top hinge tube 30 match threads on the inner surface of pendulum mount tube 62. The lower portion of top hinge tube 64 need not be threaded.

Mounting holes 68 receive the upper arm of a gas tension spring 36 as previously discussed in FIGURES 2A, 2B and 2C. The two-piece assembly of the top base of the pendulum mount is hollow to facilitate the internal passage of cables. Furthermore, the two-piece threaded assembly allows top hinge tube 64 to rotate freely in either direction with respect to the pendulum mount tube 62. A stop screw or other like device may be installed to limit the motion of top hinge tube 64 with respect to pendulum mount tube 62. This stop prevents the top hinge tube 64 from detaching from pendulum mount tube 62.

[0040] FIGURE 8 illustrates one-half of a hinge assembly. Both halves of both hinges are similar. Here, hinge assembly 66 couples to the top hinge tube 64 and is firmly attached by being pressed into, screw threads or other mechanical fastener. Within the hinge assembly 66, thrust bearing or friction wheel 70, which is further illustrated in FIGURE 9 is placed at the junction of

the two hinge assembly pieces within pocket 72. Friction wheel assembly may be constructed of nylon to prevent metal-to-metal contact when hinge assembly 66 is constructed from metal. A bolt that passes through channel 76 firmly holds two hinge assemblies 5 66 together to form the hinges. A cavity or passage 78 allows cables to run within hinge assembly 66 and any connected components of the pendulum mount. On the opposite end of support arm 34, hinge 42 couples to display screen 38.

[0041] Figure 10 depicts two hinge assemblies 66 coupled 10 together to form an integrated hinge 80. Here cables 16 run through cavity 74A, exit hinge assembly 66A, enter hinge assembly 66B and any coupled components via cavity 74B. Friction wheel 70 is located within pockets 72A and 72B. A bolt or other mechanical fastener, which passes through channel 76A and 76B, 15 holds the two hinge assemblies together.

[0042] Figure 11 provides an additional view of hinge assembly 66A and 66B mechanically coupled together wherein cables 16 pass through interior cavity 74A and exit hinge assembly 66A, and then enter cavity 74B of hinge assembly 66B. In this depiction, hinge 20 80 is bent at a 90-degree angle.

[0043] FIGURE 12 depicts support arm 34 and the counterbalance problem that the present invention addresses. Gas tension spring 36 exert tension on support arm 34 in such a way as to balance the moment of the arm. Springs or other like devices and the 25 length of section B of support arm 34 counterbalances the moment of support arm 34, having length D, and display 38 when attached. When the pendulum mount is balanced, the product of A and B equal the product of C and D.

[0044] Figure 13 depicts the integrated components that couple 30 hinge 40 to display 38. Here rotator 92 is seen within mounting assembly 90. Mounting assembly 90 utilizes a hinge assembly 66 into which rotator 92 is placed within cavity 74. In some embodiments a channel may be drilled through rotator 92 in order

to allow cables to pass within rotator 92 held within cavity 74. A rotator cap 94 secures rotator 92 to base plate 96. Base plate 96 mechanically couples to display 38 by four mechanical fasteners threaded through channels 98. Rotator cap is secured to base plate 96 by similar mechanical fasteners that pass through channels 100.

[0045] Figure 14 shows rotator 92 removed from mounting assembly 90. Base 102 of the rotator has channels 104 which are used to secure rotator 92 with a mechanical fastener to hinge assembly 66. Figure 15 provides two views of rotator cap 94 wherein pocket 106 of the rotator cap secures base 102 of rotator 92. Channels 100 receive mechanical fasteners that allow the rotator cap 94 to be securely fastened to base plate 96. Figure 16 depicts base plate 96 having channels 98 which allow mechanical fasteners to secure the base plate and mounting assembly 90 to display 38 as well as channels 108 which receive the mechanical fasteners passing through channels 100 of the rotator cap to secure a rotator cap to the base plate 96.

[0046] In summary, the present invention provides a pendulum mount to support a display screen for a dental patient. This pendulum mount includes a ceiling mount having a conduit and a base that mechanically couples to the ceiling as well as the conduit. The conduit rotates relative to the base while cables for power, video, audio or other feeds to the display screen run within the conduit. A support arm mechanically couples to the ceiling mounts with a first joint. The cables exit the conduit at the first joint and enter the support arm. Then the cables run within the support arm to a second joint. Tension between the support arm and the ceiling mount counterbalances the moment of the display screen. A mounting assembly at the far end of the support arm supports the display screen for the dental patient. Additionally, the mounting assembly mechanically couples to the support arm via the second joint. As with the first joint,

cables exit the support arm and may directly couple to the display screen.

[0047] The present invention addresses the need for a mount with multiple degrees of freedom that allows a display to be positioned so that a dental patient may view the display during all phases of dental procedures or be easily removed and not interfere with the dental procedure. Additionally, the present invention may be used in other non-dental applications where a viewer may need to reposition a display screen for viewing or storage when not in use.

[0048] Although the present invention is described in detail, it should be understood that various changes, substitutions and alterations could be made hereto without departing from the spirit and scope of the invention.